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P 154 - How do 3D skeletal parameters and demographics determine kinematic adaptation from normal to fast speed gait?

G. Mjaess[a], A. Karam[a], C. Labaki[a], J. Otayek[a], F. Yared[a], A.J. Bizdikian[a], Z. Bakouny[a], W. Skalli[b], I. Ghanem[a], A. Assi[a,b,*]

[a] *Faculty of Medicine-University of Saint-Joseph, Laboratory of Biomechanics and Medical Imaging, Beirut, Lebanon*
[b] *Arts et Métiers ParisTech, Institut de Biomécanique Humaine Georges Charpak, Paris, France*

1. Introduction

The occurrence of falls during gait in elderly people is an important source of morbidity [1]. One of the useful screening tests for falls is the kinematic analysis of fast walking, that identifies subjects with risk of multiple falls [2]. Although the kinematic adaptations from normal to fast speed gait have been studied in asymptomatic adults [3], the demographic and skeletal determinants of these adaptations are still unknown.

2. Research question

How do demographic and 3D skeletal parameters influence the kinematic adaptation from normal to fast speed gait?

3. Methods

130 asymptomatic subjects with a large age range (age:29 ± 11years [18–59], 65 F) underwent 3D gait analysis, at both self-selected normal and fast speed, from which kinematics of lower limb segments (pelvis, hip, knee, ankle and foot) were extracted in the 3 planes during the gait cycle with the calculation of specific parameters on the waveforms (minima, maxima, means, ROM). The Adaptation from Normal to Fast Speed Gait (ANFSG), defined as the arithmetic difference between the kinematic parameter during fast speed gait and its value during normal speed gait, was calculated for each kinematic and spatio-temporal parameter. Subjects then underwent full-body biplanar X-rays, from which skeletal 3D reconstructions were obtained. Spino-pelvic, hip and lower limb parameters were calculated (Fig. 1). In order to assess the determinants of the ANFSG of kinematic and spatio-temporal parameters, a univariate analysis (Pearson's correlation) followed by a multivariate analysis (stepwise-multiple-linear regression models) were computed. Each ANFSG parameter was considered as a dependent variable, with skeletal and demographic parameters as independent variables.

4. Results

ANFSG of ROM pelvic rotation was shown to be solely determined by weight ($r = 0.418$, $p < 0.001$). ANFSG of maximal hip extension was shown to be determined ($R2 = 0.115$) by femoral mechanical angle ($\beta = 0.184$, $p = 0.009$) and sex ($\beta = 0.284$;F compared to M, $p = 0.001$). ANFSG of time of maximum knee flexion in swing was shown to be solely determined ($r=-0.501$, $p < 0.001$) by height ($\beta=-0.349$). AFNSG of time of maximum knee flexion in stance was solely determined by sex ($\beta = 0.16$;F compared to M, $p < 0.001$). ANFSG of walking speed (and step length respectively) were shown to be determined solely by sex ($\beta = 0.164$, $p < 0.001$; $\beta = 0.221$, $p < 0.001$, F compared to M, respectively).

5. Discussion

This is the first study to investigate how skeletal and demographic

* Corresponding author.
E-mail address: ayman.assi@usj.edu.lb (A. Assi).

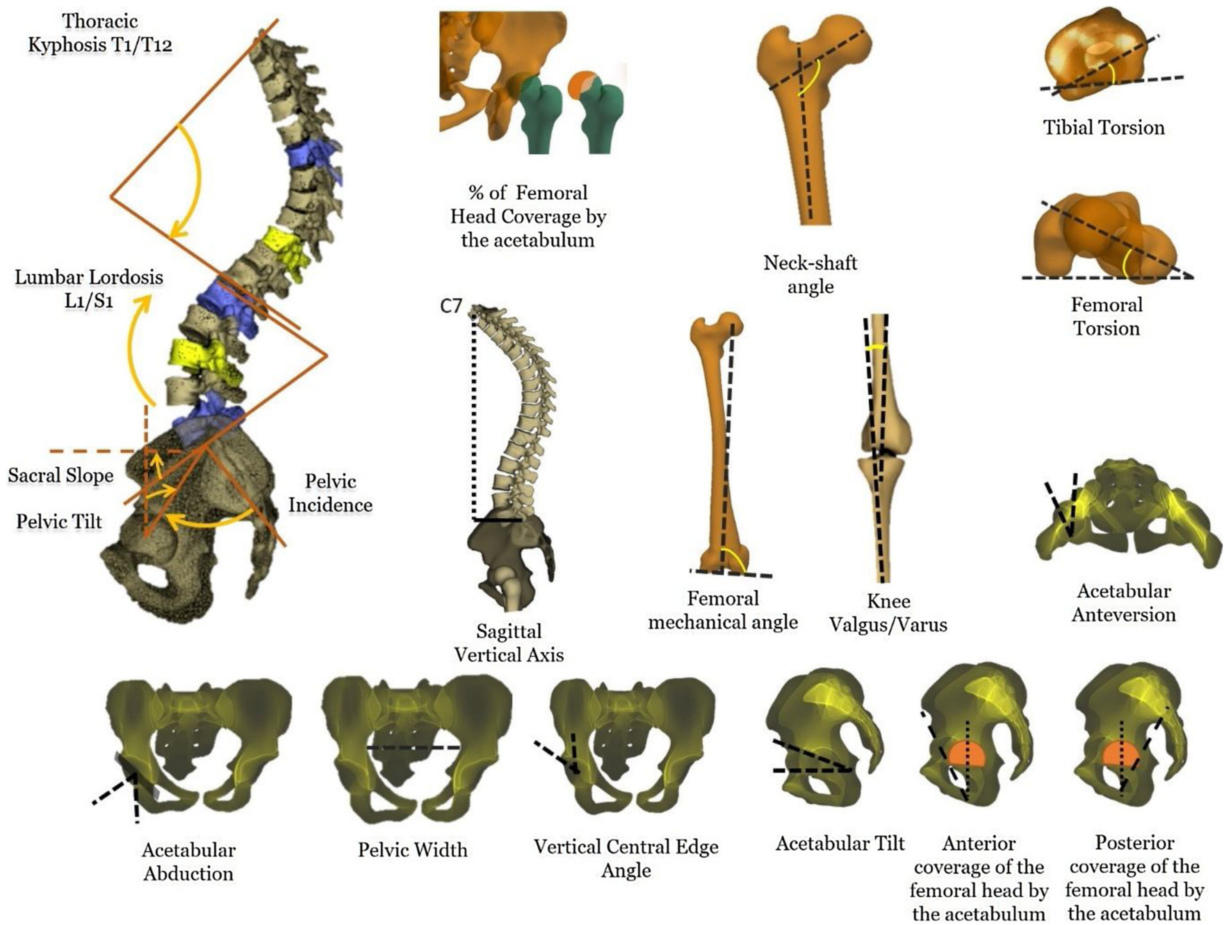

Fig. 1. Subject-specific skeletal parameters calculated from 3D reconstructions based on biplanar X-rays.

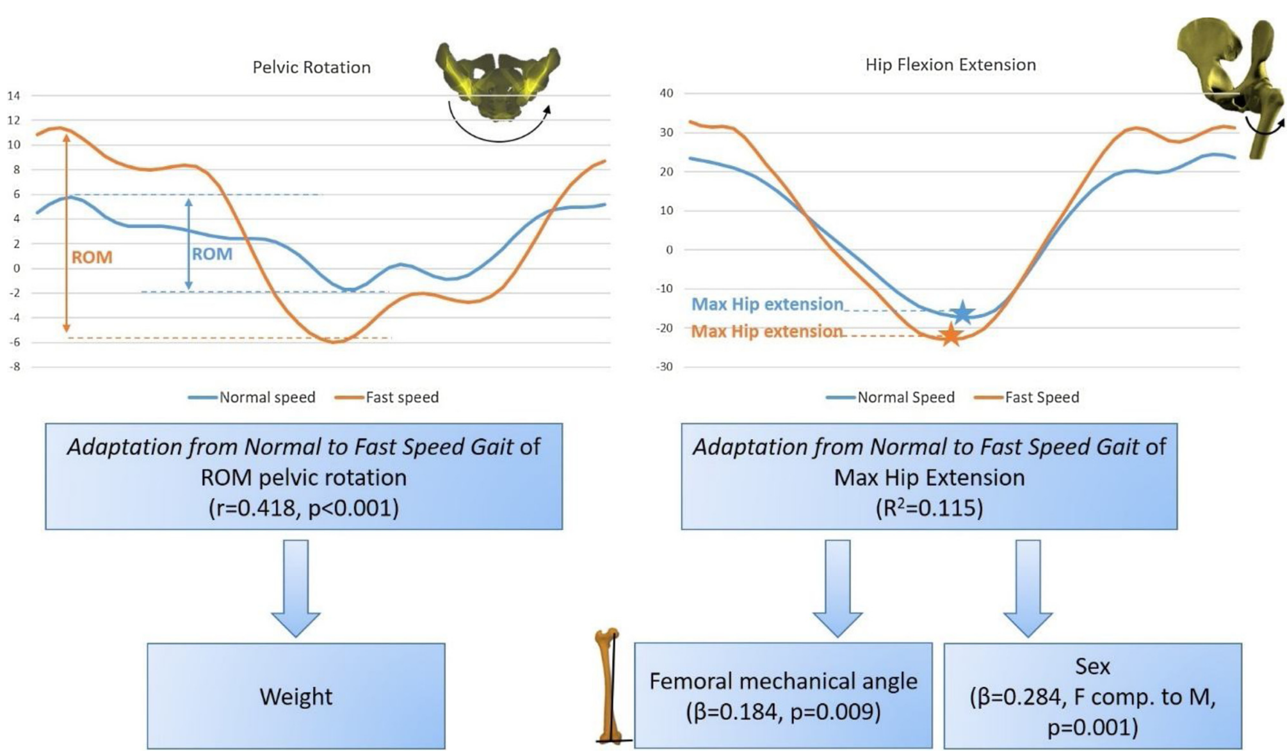

Fig. 2. Anthropometric and 3D skeletal determinants of kinematic adaptations from normal to fast speed gait.

parameters can influence gait adaptation from normal to fast speed. This adaptation seems to depend mostly on demographic parameters (Fig. 2). When adapting their kinematics from normal to fast speed gait, women tend to have a lower maximal hip extension, a higher walking speed and a higher step length, all of which could increase the risk of falls [4,5].

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